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BOOST THE CAREERS OF EARLY-STAGE RESEARCHERS

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LETTER FROM THE PAST VICE PRESIDENT

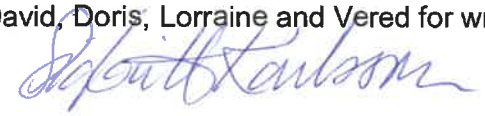
The careers of early-stage researchers are at the heart of the interests of leading research-intensive universities of Science and Technology (S&T) such as the over fifty universities united within CESAER. Boosting such careers involves bridging between science and research on one side and Human Resources (HR) on the other. One of many challenges which researchers and HR professionals are faced with lies in differences in the very perception of the world as a whole.

The context surrounding the careers of early-stage researchers is manifold. For example, the developments of key technologies for the 21st century (such as artificial intelligence, quantum technology and biotechnology) and the exponential growth of data and the importance of data science has direct impact on literally every field of science. The catalogue of political and societal expectations and challenges to universities and their researchers range from a larger engagement in regards to open science, to better serving the needs of society, business and industry and safeguarding ecological, economic and social sustainability. Employers have higher, and somewhat different expectations today than they did fifteen years ago[1]. In a rapidly changing and seemingly more complex world, it is no longer enough to be a skilled researcher.[2] Even if you know your subject well, the grand challenges of today and tomorrow demand multi-disciplinary team-based solutions, combining the ability to analyse issues on several levels with the use of a range of transversal skills.

Not only is the context subject to change, but the people choosing careers in science and research are also changing. As the new generation, commonly referred to, as ´Gen Z´, becomes an increasing part of the academic world, universities have to take the unique characteristics of this generation into account. As digital natives, having grown up in the information age, many feel empowered, connected and highly entrepreneurial, and look for the opportunity to stand out in the world and make a difference, while playing a key part in redefining the culture[3].

Against this backdrop, this white paper testifies that our Member universities are responsive to these changes and demonstrate leadership towards boosting the careers of early-stage researchers. The issues we raise and the findings, recommendations and tools we present are neither conclusive nor exhaustive, but rather derive from an analysis of literature and build on the longstanding and extensive work of our Members in general and our Task Force Human Resources in particular. In this sense, this white paper aims to inspire HR professionals at universities (of S&T) to boost the careers of their early-stage researchers, to raise awareness amongst university leaders of the importance of this topic and to showcase pathways towards improvement. We also aim to inform interested experts and the general public alike about the lines of thinking and best practice amongst our Members.

On behalf of the Board of Directors and the Presidency, I extend our feelings of gratitude to Cecilia, David, Doris, Lorraine and Vered for writing this paper.



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EXECUTIVE SUMMARY

Boosting the careers of early-stage researchers at leading research-intensive universities of S&T occurs along highly competitive and selective mechanisms. Nurturing talent for careers in science is a primary concern and interest of the institutions (institutional perspective). In chapter two, we present five tools to boost the scientific careers of early-stage researchers within universities, i.e. research-based education, research master programmes, doctoral schools, guidance to postdoctoral researchers and tenure track.

Most early-stage researchers move to careers outside universities (both research and non-research careers). That is why we address intersectoral mobility in chapter three and present dual career paths, business start-up support and permeability programmes as tools to boost the careers of researchers who will contribute to business and industry, public services, not-for-profit organisations and society at large (societal perspective). We also address recruitment of talent from outside academia (back) into our institutions.

Transmission of transversal skills to early-stage researchers is essential to increase their employability and to make them attractive on the labour market (individual perspective). Since universities cannot predict which early-stage researcher will have what kind of career, both generic scientific skills and skills to increase employability are to be strengthened in parallel as described in chapter four.

In chapter five, we introduce metrics as a well-established and indispensable tool in the recruitment, performance assessment and career development of early-stage researchers. We thereby differentiate between common HR metrics and next-generation metrics. The tricky question, of course, is how to safeguard the career perspectives of early-stage researchers while taking into account the reality of the wide-spread usage of some conventional and controversial metrics, such as publication in high impact journals.

In chapter six, we address guidance and support measures for early-stage researchers. Universities need to offer career development tools, equal opportunities and family-friendly environment and infrastructure and support staff.

While the chapters two to six contain our descriptions of the issues and present our findings on the tools, the final chapter seven contains concrete (hands-on) recommendations to department heads, HR professionals, university leaders and policy-makers and funders.

CONTENTS

1. DEFINITIONS

Discussing how to boost the careers of early-stage researchers requires clarity and agreement on terminology. In this chapter 1, we define boosting careers and early-stage researcher, and determine the scope of this paper.

1.1. BOOST CAREERS

In order to boost such careers, universities need to provide for well-designed job positions; well-structured career perspectives; career development support; advice and support for diverse career pathways; and sufficient funding.

1.2. EARLY-STAGE RESEARCHER

EURAXESS defines early-stage researchers using a temporal approach as “researchers in the first four years (full-time equivalent) of their research activity, including the period of research training.”

Research Councils UK assert that Early Career Researchers (ECR) are not a ´homogenous group´, and they instead use an approach consisting of three ECR stages, i.e. 1) doctoral, 2) immediately post doctorate and 3) transition to independent researcher.

The Research Excellence Framework (REF), which aims to assess the quality of research in UK higher education institutions, takes a more inclusive approach using the definition:

“an individual is deemed to have started their research career from the point at which they held a contract of employment of 0.2 FTE or greater, which included a primary employment function of undertaking ‘research’ or ‘teaching and research’, with any higher education or other organisation, whether in the UK or overseas, and they undertook independent research, leading or acting as principal investigator or equivalent on a research grant or significant piece of research work.”

In this white paper, early-stage researchers are referred to as postgraduate students and new faculty entering research-intensive universities, conducting research in terms of scholarship and scientific impact, engaging in learning and teaching while demonstrating leadership and contributing to the development of universities and of science.

1.3. SCOPE

We acknowledge large differences in the career paths of early-stage researchers amongst universities, research systems and countries due to different institutional development strategies, laws and regulations. Rather than presenting a comprehensive overview of these differences and of institutional best practices, with this paper we provide ideas to heads of department, HR professionals, university leaders and for policy-makers and funders on how to boost the careers of early-stage researchers at universities of S&T based on an analysis of relevant publications. Thus, this document is not meant to be neither descriptive nor prescriptive, but to be inspiring.

2. NURTURE TALENT FOR CAREERS IN S&T

Nurturing talent for careers in science is at the heart of universities of S&T. The training, recruitment and retention of excellent Principal Investigators (PI) along highly competitive and selective mechanisms is of utmost concern and interest to them (institutional perspective). Supplying the pyramid of scientific talent, whereby the independence of early-stage researchers increases constantly, is key to reaching scientific excellence. Below, we present research-led education, Research Master of Philosophy (MPhil), doctoral schools, guidance to postdoctoral researchers and tenure track as instruments to nurture talent for careers in S&T.

2.1. RESEARCH-BASED EDUCATION

Research-Based Education (RBE) lays the foundations for future scientific talent. Vertically Integrated Projects (VIP) thereby provide a transformative approach to enhancing higher education by engaging undergraduate and graduate students in ambitious, long-term, large-scale, multidisciplinary project teams that are led by faculty. The vertical integration across different levels of researchers (i.e. from bachelor to PI) is combined with horizontal integration in terms of inter- and transdisciplinary, collaborative working and learning on 'real' research objectives and delivering impact[4]. Benefits of RBE and VIP concern long-term experiences of students with the innovation processes, leadership and mentoring of research staff, faculty scholarship and exploration and contributions to tackling real-world problems. Linking the Social Sciences and Humanities (SSH) with Science, Technology, Engineering and Mathematics (STEM) is particularly important.

2.2. RESEARCH MASTER OF PHILOSOPHY

Acknowledging the sometimes substantial research components in Master of Arts (MA), Master of Science (MSc) and Master of Engineering (MEng) programmes, we point to the opportunities of the Master of Philosophy (MPhil) as a postgraduate research master. Unlike other master's qualifications, the MPhil is a pure research degree and based entirely on the completion of an independent thesis. The MPhil may be regarded as an advanced master's degree and, while the research being undertaken is under the guidance of an academic supervisor, it does not normally incorporate timetabled classes or assessments. As an advanced research qualification, an MPhil often requires a master's degree (MA or MSc) as a prerequisite. Though its full title identifies it as a master's degree, the MPhil is positioned between other master's qualifications and advanced postgraduate research training such as a PhD.

2.3. DOCTORAL SCHOOLS

Doctoral schools provide continuing education and transferable skills training opportunities for doctoral candidates. The focus is on skills which are important for doctoral studies and subsequent careers. One challenge for early-stage researchers is not only to possess excellent subject-oriented skills, but also a broad range of skills outside of their discipline. Doctoral schools are advised to place emphasis on introducing the basic principles of good scientific practice to researchers at an early-stage of their independent academic career. However, considerable differences in national research and higher education systems, e.g. whether there are credit systems for PhD or not, pose big challenges to (inter-institutional and trans-border) doctoral schools.

2.4. GUIDANCE TO POSTDOCTORAL RESEARCHERS

The postdoctoral stage is an important phase in which decisions about the future career path of researchers are made. In addition to sharpening their scientific profile - and if the chosen career goal requires - non-subject-specific skills and competencies need to be obtained. Supporting postdoctoral researchers in their development as scientists as well as in their career planning is a high priority of universities: they are encouraged to provide guidance to postdoctoral researchers emphasising equal opportunities, transparent career paths and framework conditions that maintain high-quality standards. Other basic requirements for the effective development of research careers are attractive employment offers, well-designed job positions and sufficient funding. Guidance to postdoctoral researchers is given in the form of clear and supportive guidelines.

2.5. TENURE TRACK

There are several models for tenure track, mostly related to the legal context in which they are offered, 1) probation-on-the-job (UK), i.e. permanent employment at an early career stage and career progression through a promotion board; 2) two-tier promotion and ´habilitation´ (Central Europe); 3) centralistic with state approval (France) combining tenure and ´habilitation´; and 4) North American tenure track.

Meeting the following preconditions helps to optimise tenure track positions. Independence in teaching and research must be safeguarded at all times. Institutions need to know and operate within the (national) legal context and limitations. A tenure track position should provide a pathway to promotion to a regular permanent position. Universities may wish to consider establishing a system of checks and balances and well-defined competencies and duties of players involved. They can establish clearly defined and transparent processes and criteria at the start of and throughout tenure track programmes and provide an up-front financial guarantee: tenure must not be dependent on the availability of funding for the post. We advise to periodically and continuously monitor (e.g. annual, mid-term) personal, professional and academic aspects. Finally, universities ideally provide support for personal, professional and academic growth, safeguard a competitive international recruitment process and base decisions on competence, skills and aptitude.

Tenure track allows for the coexistence of different types of research careers: traditional professorships, Assistant Professor (AP) positions with or without tenure track and PI holding grants from the European Research Council (ERC) or a national funder. It increases the capacity to implement institutional strategies e.g. an increase in the number of AP and rejuvenation of faculty. It is an effective instrument for attracting and retaining young talent as it allows for hiring and promoting high-potential researchers in their most productive phase. Tenure track broadens the toolbox of the institution to boost its international competitiveness.

When recruiting to tenure track, one may wish to consider part-time positions for professors and different career tracks (associate, full professors). Evaluating the teaching competence next to research excellence by the search committee is crucial. In essence, the evaluation addresses the potential in terms of the candidate's vision and research plan.

Successful advancement in a tenure track involves giving confidence in the track (researchers have the right to be evaluated and be able to continue if they are good), attracting candidates from diverse backgrounds and securing funding. We advise envisaging a 75-80% success rate, to provide mentorship, supervision, development discussions and plans (appraisal systems), and to support individuals who do not continue their tenure track to find a new job.

Institutions are advised to provide support to holders of tenure track, such as allowing different practices on sabbaticals and research leaves depending on institutional targets and situation, provision of courses in pedagogy, mentoring and language, offer several career tracks and support international mobility. During the recruitment, candidates need relevant information and support if relocating from abroad to a new country and professional prospects for any partner guaranteed through the collaboration with organisations close by, networking with co-nationals, and provision of childcare support at the university. Furthermore, work profile adjustment may be based on career stage, funding provided for special projects, community-building activities stimulated and inclusiveness in activities and language promoted.

Given the highly competitive nature of tenure tracks towards scientific excellence, researchers face common challenges, such as publication pressure, too much focus on Citation Impact Score (CIS) and difficulties in securing funding. Universities thus need to assume special responsibilities and create adequate conditions and communicate them early on when working with tenure track. These common challenges include - amongst others - developing new approaches to recognise and appreciate of scientists in a balanced way (see also chapter 5 ´Provide metrics boosting scientific careers´). For example, there must be sufficient appreciation for all three core tasks of the university: education, research and knowledge transfer. Moreover, it is crucial that the transition to open science is encouraged and good academic leadership is recognised.

3. FACILITATE INTER-SECTORAL MOBILITY

Larger populations of PhD candidates[5] across the world increase competition on the job market. In the past decade, the number of doctoral degrees awarded in the EU has risen by 27%[6]. Most of these PhD candidates will move to non-academic careers in industry, business, public bodies and not-for-profit organisations. Only 20-30% of PhD candidates in STEM will stay in academia after gaining their PhD. Despite that, supervisors and PI tend to focus on and reward the development of a career in academia. Early-stage researchers often have little experience outside academia and may be reluctant to move into industry, where they fear working conditions are more restrictive than in academia[7 8].

As most researchers educated and trained at universities do not end up in academia, universities have to assure their employability on the labour market, thus supplying the labour force of tomorrow. Intersectoral mobility thus concerns all possible bridges built between university on one side, and non-academic employers from business and industry, public services, and the not-for-profit sector, on the other. It is imperative to create the right conditions for the best possible career prospects of early-stage researchers outside academia as well as to attract promising scientific talent (back) into academia. Examples of relevant skills and competencies for successful inter-sectoral mobility include practising open science and innovation, developing S&T communication, nurturing entrepreneurial mindsets and cultivating creativity.

Dual career paths, business start-up support, permeability programmes and recruitment of talent from outside academia are presented below as effective means to facilitate intersectoral mobility of early-stage researchers.

3.1. DUAL CAREER PATHS

With dual career paths we mean a parallel employment in an academic and a non-academic environment. The delineation and implementation of new and transparent career paths in academia, aside from professorship, result from a structured assessment of the conventional scientific fields of work. For example, individuals with a doctorate, experience in science and skills in project management, but who are also skilled in organisational development, personnel management, and in business administration, can pursue a career as science managers. In a university, they may work, e.g. in faculty administration or in the management of divisions in central administration, generally on the basis of a permanent employment agreement.

There is a trend towards the majority of doctoral candidates (up to 80%) leaving university directly after their doctorate in order to take up a position in non-academic organisations[9 10 11 12 13]. Close contact with potential non-academic employers from e.g. business and industry during the doctoral qualification phase helps PhD candidates explore career paths outside academia. Particular attention and guidance are needed given the high expectations of doctoral candidates in engineering and the natural sciences to assume project responsibility and managerial roles.

A career path as an industrial manager with management responsibilities is targeted at early-stage researchers who are interested in management, business, and economics, and wish to fulfil a (high) management position. This not only requires professional qualifications, but also management expertise.

3.2. BUSINESS START-UP SUPPORT

Universities ideally offer support concerning intellectual property, business start-up, technology acceleration and incubators. Postdoctoral researchers who have developed a business model based on their research activities and who are interested in setting up their own business deserve the opportunity to receive guidance and support from the university's advisors. Experts from the responsible department and the entrepreneurship centres can answer questions regarding the protection of Intellectual Property Rights (IPR) and strategies for commercial exploitation. Furthermore, they can provide information on funding opportunities for entrepreneurs.

3.3. PERMEABILITY PROGRAMMES

Permeability programmes between academia and other sectors aim to:

- promote career paths outside academia;
- encourage permeability between academia and other sectors;
- build stronger networks of R&D professionals into academia in order to increase the percentage of excellent researchers and teachers at universities;
- support future inter-sectoral collaboration.

Such programmes seem to be gaining momentum in Europe as an HR issue for early-stage researchers. However, these practices are still not widely accepted as a strategic priority of national funding, and the impact of funding schemes on researcher careers is difficult to measure as the IPR regulations are not applicable for specific support schemes and measures.

3.4. RECRUITMENT OF TALENT FROM OUTSIDE ACADEMIA

Filling academic positions with talent from outside academia needs an `active sourcing´ approach. This includes expanding human resources marketing at the international level and the targeted placement of job postings in international media. Special appointment processes can be supported by the targeted identification of highly qualified female applicants. Importantly, universities need to assess informal and non-formal learning of scientific talent in other sectors.

4. TRANSMIT TRANSVERSAL SKILLS

With increased inter- and transdisciplinary collaboration, remote and cross-cultural communication and complex issues to solve, the need for ´transversal skills´ increases regardless of whether an early researcher continues in academia or not. Universities need to equip their researchers with skills supporting successful careers[14] [15]. These skills are defined using different terms, such as soft, generic, transversal, transferable, professional and personal. The International Bureau of Education of the United Nations Educational, Scientific and Cultural Organization (UNESCO) defined transversal skills as "skills that are typically considered as not specifically related to a particular job, task, academic discipline or area of knowledge and that can be used in a wide variety of situations and work settings."[16]. In 2016, this definition was completed with six domains, i.e. critical and innovative thinking; interpersonal skills; intrapersonal skills; global citizenship; media and information literacy; and others[17].

The structures around the transmission of transversal skills can be similar, and sharing of best practices among universities is useful[18]. Apart from defining what skills and competencies to focus on, the university also needs to monitor expectations from employers. This speaks in favour of creating an institution-wide centre developing high-quality courses within transversal skills. This centre is responsible for defining the offering, determining content and monitoring quality of the courses.

The more the development of transversal skills is integrated into the researcher's work (research, teaching and dissemination), the better the understanding, the deeper learning and the quicker application of these skills. There are two ways to work on this: 1) bring the participants' reality into the training (adapting content and exercises to the students' knowledge area) or 2) bring the training out to the participants reality[19] (application of learning). When introducing transversal skills training, universities may choose from push and pull strategies, e.g. 1) make it a mandatory building block of PhD programmes and 2) promote cultural change whereby students and supervisors consider transversal skills vital in nurturing demand for training such skills.

There is a need to evaluate the effects of transversal skills training as part of research education. So far there are studies of transversal skills as part of secondary education[20] and it is not yet confirmed that the results are transferable to PhD candidates. Soft skills are hard to measure, but research is advancing in the area of defining and measuring soft skills[21] [22]. Kirkpatrick's model[23] for evaluating training contains four levels, ranging from happy participants, but they do not necessarily have the skills as defined in the learning objectives (level 1) to results of training applied in everyday work situations (level 4). PhD candidates and postdoctoral researchers might not see the full use of transversal skills until they have worked for a couple of years[24]. Only then can we fully acknowledge the impact of transversal skills training, in terms of what use they had of their transversal skills, employability of PhD candidates and postdoctoral researchers within and outside academia and employers' perception of competency gaps when hiring our alumni.

While the acquisition of generic scientific skills is at the core of boosting the careers of early-stage researchers, we also discuss skills to increase employability.

4.1. GENERIC SCIENTIFIC SKILLS

Early-stage researchers who are actively enhancing their scientific profile need support to acquire generic research skills (such as research methods, statistics and academic writing) and teaching competence. Moreover, universities are advised to place particular emphasis on encouraging early-career faculty to undertake research responsibly ensuring that the principles of good scientific conduct and best practices in Responsible Research and Innovation (RRI) are respected. Particularly in STEM, early training in ethics and values is crucial to make early-stage researchers aware of the (potential) impact of their research findings and technologies.

The transition to open science is one of the top priorities of many universities. Early-stage researchers thereby need support with ensuring open access to their scientific publications and other research results, the application of the Findability, Accessibility, Interoperability and Reusability (FAIR) guiding principles for scientific data management and stewardship, and Research Data Management (RDM). Openly publishing data and software can be an especially effective means to boost the careers of early-stage researchers. University libraries are essential for both the provision of support and guidance on open science, and for running the corresponding infrastructure such as text and data repositories, databases and analysis tools. The Declaration on Research Assessment (DORA) and its implementation thereby provide guidance to safeguard research quality in an open access publishing context.

The exponential growth of (scientific) data offers great opportunities to early-stage researchers. They thus need to acquire basic and advanced data science skills. Linking SSH with STEM amplifies these opportunities, but requires inter- and transdisciplinary collaboration skills.

Another important soft skill that benefits researchers is presenting their work in a popular scientific way. This enhances communication skills[25], assists in disseminating research results, supports networking and finding useful connections and entry points as well as building a better understanding of their research[26] when having to explain it in language accessible to non-specialists. Other areas relevant in research, as well as outside academia, are research ethics and the philosophy of science. The general assumption behind engineering is that engineers work to fulfil the needs of society, and as such engineers are expected to act ethically towards society. That calls for an ability to see their own work in relation to society at large, both from a micro and a macro perspective as well as in short- and long-term perspectives.

The teaching activities and knowledge transfer of postdoctoral researchers are considered an important component of their qualification. For this reason, educational offerings are provided to help them improve their ability to supervise and guide doctoral candidates and students. Academic leaders and managers at universities shall give researchers the time and sufficient leeway to engage in these important activities. It is important that early independence of the postdoctoral researcher and responsible leadership on the part of the supervisor go hand in hand. Participation in national and international conferences helps to ensure and increase the visibility of early-stage researchers and their research findings. Additionally, applications for scientific awards, fellowships and external fundraising can be actively supported. These measures are important for national and international competitiveness of the postdoctoral researchers.

4.2. SKILLS TO INCREASE EMPLOYABILITY

Scientific knowledge is not enough for a future career; within or outside academia[27] [28] [29]. Combining research in the field of science with competence development in the areas of communication, networking, pedagogy, leadership and utilisation will increase employability as a researcher in a knowledge-oriented world. It is reasonable that the definitions of soft skills relevant to researchers need to vary depending on disciplines taught as well as profile and vision of the institution.

In 2011, the European Commission (EC) defined seven principles of innovative doctoral training[30], including transferable skills training and encouraged universities to include transversal skills training in their PhD curricula. It is not yet a fully adopted practice, but can provide a competitive edge for universities as their PhD candidates obtain higher employability. Universities have implemented transversal skills training in different ways: from defining what these competencies are, how prioritisations among skills are made, the body responsible for ensuring the skills are learned, to how the training delivery is organised. The definitions of skills vary depending on the disciplines taught, as well as the profile and vision of the institution.

Universities face a number of challenges while implementing transversal skills training for PhD candidates. Competition in science has increased and researchers - including PhD candidates - need and want to spend every hour on their research topic to stay ahead[31] [32]. This leads to difficulties in finding time to participate in transversal skills training and a lack of prioritisation of transversal skills development among PhD candidates and their supervisors.

The UNESCO definitions[33] provide guidance when defining the right skills and competencies. Moreover, the profile and image of the university and the expectations from employers may be taken into consideration. Preferably, the university offers a variety of courses and lets PhD candidates and postdoctoral researchers choose courses depending on their career plans. For PhD candidates to choose wisely, they first need to define their future ambitions and goals. They would benefit from understanding their job prospects, the limited number of available positions in academia and having an overview of careers outside academia[34].

5. PROVIDE METRICS BOOSTING SCIENTIFIC CAREERS

Metrics can provide for true and meaningful perspectives on scientific careers. However, there is a certain tension between quantitative and qualitative approaches in HR and also the levels that are addressed, e.g. individual, group, institution and system. Whilst researchers, teachers and students are often cited as being an institution's 'most valuable asset', they present a fundamental challenge to university leaders and HR professionals to successfully source and develop them in the global context and the 'war for talent'[35].

It is generally accepted that poorly aligned systems and structures, unable to support, develop and enhance institutional talent, have a negative impact on overall delivery and performance. Whilst the origin of HR metrics is rooted in the need for organisations to assess the (financial) value of its people, more recently individual aspects, such as diversity and capability, are considered and HR metrics have evolved to incorporate concepts such as employee well-being, engagement and culture.

In the context of early-stage researchers, careful consideration needs to be given to the overall purpose and value of utilising HR metrics. We first discuss common HR metrics. They are challenged by developments inside and outside academia. A particular concern is the high pressure to publish in high impact journals. More than 30% of PhD candidates were reported to suffer from anxiety or depression and a systemic change to research cultures is needed[36]. Next generation metrics are essential to cope with these internal and external developments.

5.1. COMMON HR METRICS

Gathering and utilising metrics is not a new phenomenon within HR and there are extensive examples available whereby HR data is gathered and analysed to examine the impact on an institution's productivity, finances and overall effectiveness[37]. There is an ongoing debate as to the applicability of quantitative data in assessing the success of an organisation's HR function in supporting early-stage researchers in an academic context. The fundamental question to is 'why' and 'how much'.

Effectively utilising HR metrics to assess research, teaching and knowledge transfer enables institutions to assess and analyse their overall recruitment and staff development strategies to deliver against institutional objectives. HR metrics can be utilised by decision makers to assess how successful an institution's recruitment and staff development practices are in attracting and retaining the very best early-stage researchers. Through analysing the 'quality of hire' of early-stage researchers, within the probation period or annual performance appraisal system, an institution can review the rate of attrition, both on a voluntary and involuntary basis, and effectively assess the data against previous years. Capturing valuable data, in the form of exit interviews, can provide insight into the overall success of hiring practices and provides an opportunity for an institution to revise their recruitment strategy accordingly.

It is widely understood that HR metrics can be utilised to quantify the impact of employee programmes and HR processes, and that metrics can be effectively used to measure the success of HR initiatives. It is generally agreed that metrics provide answers to questions but the fundamental question to be explored by HR professionals in this context is 'are we asking the right questions?' While metrics can empower institutions to address pressing strategic issues and guide the implementation of specific pathways, an institution firstly needs to be clear on what issues are being faced and what pathways are being sought.

HR excellence requires an institution to constantly assess and revise practices, and introduce initiatives to affect a positive impact or desired outcome. However, the question is 'will quantitative data help us?' and if so 'what metrics are we measuring and to what extent?'

5.2. NEXT GENERATION METRICS

Universities face internal and external challenges when attracting, retaining and developing (top) talent. While HR metrics can be effectively utilised in the context of assessing the systems and practices that are put in place to support early-stage researchers, consideration needs to be given to the strategic issues currently being faced by universities and to how quantitative data can be utilised effectively for recruitment, performance management and professional development of early-stage researchers. When devising and implementing personal development pathways, existing operational practices need to be reviewed to enable 'the right person to be in the right role at the right time'. The Leiden Manifesto for Research Metrics[38] serves as an important guide when designing and applying (next generation) metrics to successfully attract and retain the best and brightest scientific talent from across the globe.

A first important challenge concerns the balanced assessment and reward of research, teaching and knowledge transfer at the level of individuals, as especially research-intensive universities tend to reward their scientific staff primarily on the basis of research performance.

The transition to open science requires a profound change in the metrics used to assess and reward research performance[39], moving away from CIS and H-index towards indicators capturing openness, such as ´peer-reviewed publications in open access journals´ for individuals and ´percentage of interdisciplinary publications compared to all publications in open access journals´ for entire institutions.

Moreover, universities increasingly address the complexity of evaluating inter- and transdisciplinary, ground-breaking and incremental science, and the use of international peer review in assessment, particularly in their internal quality assurance.

Universities need to establish and safeguard Equality, Diversity and Inclusion (EDI), see also our recently published white paper and best practice examples from our Members. Universities define and apply metrics and targets to the management and promotion of employees for the purpose of widening participation and ensuring diversity. Collating EDI metrics is used to assess progression opportunities and career movements, and to assist in identifying institutional trends in the context of existing promotion and development practices.

There is also a trend to look more and more into the impact of research and education. While many efforts have been undertaken to assess the contribution of universities in creating jobs and boosting economic growth, the current challenge is to grasp their contribution to ecological, social and economic sustainability.

Whilst attracting suitably skilled individuals is the initial stage in the employee lifecycle of an early career researcher, effectively managing performance and supporting development is a crucial element to the overall success of this cohort. Through assigning a mentor, setting objectives and providing regular feedback, early-stage researchers have clarity on the expectations upon them in terms of what success looks like within their discipline. Eliciting feedback from academic peers can provide valuable input into a structured system whilst providing a framework for ensuring an effective feedback mechanism.

6. PROVIDE GUIDANCE AND SUPPORT

To ensure that early-stage researchers focus on achieving the best research and develop to their full potential, universities can adopt a people-oriented approach. Individual career plans and high-quality mentoring[40] are offered, equal opportunity challenges addressed and a clear HR approach adopted, creating an environment where personnel strive for and achieve excellence in every respect. In this chapter, we describe career development tools, equal opportunities and family-friendly environment and support staff and infrastructure.

6.1. CAREER DEVELOPMENT TOOLS

Each early-stage researcher deserves an individual development plan, including long-term goals, to be completed and revised every year. This calls for involvement of the supervisors to lead this dialogue and act as role models and mentors[41]. The university can offer training to supervisors and expect them to develop skills such as contracting, coaching, (interactive) education and training techniques and feedback. The university can also provide information and encourage supervisors to have a broad and up-to-date view of careers outside of academia and encourage collaboration with third parties. There is great value in combining researchers and practitioners[42] as the culture clash between a theorist and a practitioner in the same field can be greater than that between cultures. There is a need to understand the different perspectives, priorities and perceptions of the problem to be solved for interdisciplinary work to be successful[43]. Shortly after the doctorate, such an individual development plan is formulated defining the research foci, objectives for professional activities and medium-term career perspectives. The decision on scientific foci takes place in the first qualification phase. Qualification needs are identified and measures to gain them offered. Researchers and supervisors agree upon milestones and perspectives during appraisals.

6.2. EQUAL OPPORTUNITIES AND FAMILY-FRIENDLY ENVIRONMENT

Universities are advised to be aware of the various challenges their researchers face at the different stages of their careers. It is crucial to support and supervise them appreciating aspects such as gender, nationality, ethnic origin, religion, ideological affiliation, disability, age, sexual orientation and identity. In order to achieve equal opportunities, strong support for women to assume leadership roles within and outside of academia is needed. In case of prolonged absences due to family responsibilities, superiors are encouraged to support researchers to resume responsibilities through counselling and advice services. International researchers and their families need and deserve particular support in preparing for and undertaking their stay, so as to offer them the best possible start at a university.

6.3. SUPPORT STAFF AND INFRASTRUCTURE

Ensuring a good ecosystem around early-stage researchers will lead to higher satisfaction, better progress and high-quality work in terms of higher achievements and high-quality research. Universities need to provide relevant and excellent infrastructures to researchers, e.g. the best machines, appropriate rooms and equipped laboratories. HR can provide for competitive advantage by recruiting high-quality personnel to support early-stage researchers: highly qualified administrators, the best technicians etc., thus creating a support team that will benefit them. Moreover, HR needs to make researchers aware of the rules and regulations regarding employment, safety and accepted practices.

7. RECOMMENDATIONS

In the previous chapters, we described the careers paths of early-stage researchers and elaborated on selected mechanisms to boost their careers. In this last chapter, we summarise concrete recommendations to department heads, HR professionals, university leaders and policy-makers and funders.

7.1. DEPARTMENT HEADS

The enhancement of research and teaching skills lies at the core of the responsibility of department heads. For early-stage researchers, the emphasis ideally is high with research (and artistic work in for example design and architecture) in the beginning of their career, while the teaching load is kept relatively constant and service (activity in scientific and artistic community, academic leadership, societal interaction) increases with seniority. In order to reach tenure, candidates must have 1) excellence (ground-breaking) in research (and artistic work), and high-quality teaching or 2) excellence (outstanding) in teaching and high-quality research (and artistic work). By doing so, universities lay the foundations for two paths towards tenure: one focused on research and one on teaching. Moreover, departments heads are advised pay special attention to postdoctoral researchers that return from non-academic sectors as they might need to acquire additional teaching and research skills. Particular attention is needed to support early-stage researchers in avoiding the problems deriving from ´hyper-competitiveness´. Essentially it is about establishing a kinder research culture[44] and combating toxic environments of bullying and harassment[45].

Department heads are encouraged to provide guidance in the formulation of individual career plans for their early-stage researchers. Criteria that are predictable, transparent and comparable with international standards are the basis for such plans allowing the assessment of the qualification needs and defining research objectives and milestones. In order to maximise ground breaking research output and career development, a constant flow of ideas and talent must be established balancing the interests of early-stage researchers and their employing universities alike. Enforcing regular changes of academic environment throughout the career is a way of achieving such flow. Another one is a ‘competitive’ policy whereby only a defined percentage of early-stage researchers is provided with the opportunity to retain an academic position and the others exiting from position and transitioning on a rolling annual basis. It is important to communicate such targets and expectations clearly and early on and to discuss career paths that align with the candidate’s abilities and preferences encouraging researchers to talk about their challenges and to identify actions to tackle them. We advise department heads to promote the international visibility of their postdoctoral researchers (e.g. through participation in international conferences) to boost their competitiveness.

We suggest assigning a dedicated mentor to provide critical and constructive feedback and advice. Such mentors ideally are more senior researchers preferably in other areas and universities that provide wider perspectives and encourage early researchers to acquire a wide range of (interdisciplinary) skills. Importantly, we strongly advise to not use supervisors for tenure trackers. Department heads can evaluate their efforts, follow their alumni and ask for feedback on their research and education, interview them to discover what career choices they made and what use they had of their transversal skills. Measuring employability of PhD candidates and postdoctoral researchers within and outside academia and surveying industry and authorities helps ensuring they get the competencies needed when hiring alumni.

It is important to avoid losing out and to create win-win opportunities like letting early-stage researchers present their research in a popular scientific setting thus improving communication skills useful in all jobs, increasing the understanding of their research when having to explain it, disseminating research results, as well as networking and finding useful connections and entry points in other sectors. Early-stage researchers thus need to be trained for the broadest labour market. The widening of perspectives - such as doing a postdoctoral experience at another university, in another country and in a different research area - increases learning. Partnering researchers and practitioners to create an understanding of each other's perspectives and priorities, to solve interdisciplinary challenges also helps.

Particular attention is needed to secure (third-party) funds and awards for early-stage researchers, as many of them depend on external funding sources and are usually not trained in the acquisition of funding and awards. Department heads can proactively support early-stage researchers in the acquisition of external funds, the application for grants, and the nomination for research awards, as grants and awards are instrumental in building the reputation of researchers. This entails making them aware of funding opportunities (e.g. calls for application) and career development opportunities. After having obtained such funds, postdoctoral researchers require care, particularly in engineering and technology, as they often have to deliver and fulfil contractual expectations and agreements with third parties.

The provision of high-quality infrastructure is key to enabling early-stage researchers to focus on their research and to achieve scientific excellence. This concerns physical infrastructure (such as laboratories, machines, rooms, equipment, networks) and staff, including administrators and technicians. Informal meeting spaces are pivotal in creating interdisciplinary added value.

7.2. HR PROFESSIONALS

HR professionals are strongly encouraged to collect and use HR-related data providing evidence on scientific careers. Agreement on (objective) data collection allows for its use in criteria for same-level recruitments and advancements, application of targets and retrospective analysis and assessment. The collection and use of data is paramount for the improvement of HR strategies, policies and procedures, paving the way for benchmarking of best practices and contributing to more unified systems within and amongst universities.

The provision of in-house training is crucial to integrate new talent into the institution and making them familiar with relevant policies and procedures. Rather than focusing on the obligatory nature of such training, we recommend using common sense and peer pressure to assure attendance. We encourage HR professionals to train and monitor mentors and supervisors.

We recommend to develop and utilise individual development plans which link development and training requirements to each element of the academic position with Key Performance Indicators (KPI). The KPI are set at intervals assessing (quality of) output. Structured and regular one-to-one appraisal meetings are paramount. The provision of 360-degree feedback to capture and analyse student and manager feedback with numeric ratings applied is important. We advise to assess individual scores against institutional values and behaviours in action (weighted as appropriate), to implement practices whereby peers provide observational assessment of teaching methods and student engagement and to assess performance against clear scoring mechanisms.

HR professionals have an important task in assuring awareness of relevant laws and regulations and their implications for equal opportunities and inclusion. They thus inform and make early-stage researchers aware of rules and regulations regarding a wide range of topics, including employment, safety and accepted practices in the university.

In essence, HR professionals ought to create favourable framework conditions for, provide high-level support to and ease stress upon early-stage researchers with special guidance to postdoctoral researchers and with special attention to tenure trackers.

7.3. UNIVERSITY LEADERS

We advise university leaders to identify ´scientific talent´ from amongst the (post) doctorate researchers through departments rather than individual professors. Importantly, we advise university leaders to establish and justify several career tracks, think of research versus teaching; ´normal´ (public servant) permanent full-time professorships versus tenure track; different types of tenure track in terms of early versus advanced; and different associate professorships.

Leaders are encouraged to introduce tenure track, but must realise that long-term periods are not always possible (for legal reasons) nor wanted (for personal reasons) and that tenure track is a short period for collecting all needed merits and skills. University leaders must at all times safeguard the balance between a) institution-wide quality standards (e.g. tenure committee) and b) faculty-specific interpretation (i.e. scientific performance criteria per discipline; allocation of research budgets and composition of tenure track committee and evaluation procedure). The following key players ought to be involved in tenure track:

- (Departmental) tenure track committee; appointed for each recruitment/promotion case separately to prepare appointment/recruitment proposal based on external reviews and statement on teaching competence;
- School teaching competence assessment committee to assess the teaching competence of candidates in recruitment or promotion cases for professor or lecturer career systems;
- School level tenure track committee to advise deans in recruitment and promotion of staff;
- Dean who makes decisions on non-tenured positions and proposals to the president of the institution on tenured positions;
- University-level tenure track committee to give recommendation to president in every recruitment and promotion case involving a tenured professor position;
- President who decides on professor position allocations, fields, appointments and promotions to tenured positions.

University leaders are advised to adjust the assessment and reward systems within their institutions in order to enable their staff and institutions to tackle the internal and external challenges. More generally, university leaders are advised to regularly evaluate and adjust the HR policies, regulations, guidelines and procedures.

We recommend to involve early-stage researchers in the academic leadership and university governance by e.g. inviting them to participate in university bodies and committees. Involvement will enhance the connection and engagement to the institution, increase the relevance of decisions made to researchers, and therefore the likelihood to achieve excellence and to have creative and productive contributions[46].

There is strong and continuous evidence that gender inequality is a long-standing challenge at universities and thus urgent action by leaders, universities and stakeholders is necessary[47] [48]. We invite university leaders 1) to establish gender balance in all decision-making levels and advisory boards; 2) design, implement, monitor and evaluate dedicated policies and plans for EDI and implement concrete actions to accelerate them; 3) set institutional targets for EDI at all levels and monitor and communicate the progress of achievement; 4) promote a learning community of institutions to learn from each other; and 5) develop guidelines against discrimination.

Universities are competing for the top talent with other universities and non-academic employers. As the employment market is constantly in flux, early-stage researchers are highly appreciated assets, frequently courted and often perceived as the strength of the future of science and industry. Thus, they deserve to be paid attractive and comparable salaries.

7.4. POLICY-MAKERS AND FUNDERS

The current (national) labour laws for researchers are often rigid. We call upon governments to make them more flexible thereby increasing the institutional autonomy to allow several career tracks, notably enabling universities to establish tenure track positions.

Universities build up and maintain talent pyramids from the bachelor to the PI levels and therefore depend on public funding for PhD and (intersectoral) mobility to enlarge such talent pools. Proactive support of early-stage researchers with funding, grants and research awards is instrumental in building the reputation of researchers and enabling scientific progress. Incentives for tenure track or funding special projects will enhance the ability of researchers to focus on achieving the best research, adding to scientific knowledge, opening new career development opportunities and ensuring that their hosting universities progress as well.

Investments in high-level infrastructure, e.g. the best machines, extensive computer abilities, equipped laboratories and appropriate rooms and buildings, are important to the development and enhancement of high-quality science. High-level infrastructure enables involvement in the generation, diffusion, and utilisation of technology, enabling faster and easier modes by which technologies are appropriated and accumulated, and promotes the ability to enter into collaborative arrangements[49] [50].

Working in science is different from other parts of the labour market and governments must establish favourable framework conditions by adopting fast-track immigration procedures for knowledge migrants and addressing family and special needs. Importantly, legislation must assure a decent living of highly mobile early-stage researchers concerning social security, health insurance, unemployment and pension.

ANNEXE I: LIST OF ABBREVIATIONS

ABBREVIATION	MEANING
AP	Assistant Professor
CIS	Citation Impact Score
EC	European Commission
EDI	Equality, Diversity and Inclusion
ECR	Early Career Researcher
ECTS	European Credit Transfer and Accumulation System
HR	Human Resources
IPR	Intellectual Property Rights
KPI	Key Performance Indicators
MA	Master of Arts
MEng	Master of Engineering
MPhil	Master of Philosophy
MSc	Master of Science
PI	Principal Investigator
RBE	Research-Based Education
RDM	Research Data Management
RRI	Responsible Research and Innovation
S&T	Science and Technology
SSH	Social Sciences and Humanities
STEM	Science, Technology, Engineering and Mathematics
UNESCO	United Nations Educational, Scientific and Cultural Organization
VIP	Vertically Integrated Project

ANNEXE II: LITERATURE

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